STAT

Experiment in Organizing a Field Calibrating Station

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EXPERIMENT IN ORGANIZING A FIELD CALIBRATING STATION

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The accuracy of water discharge determination by means of hydrometers depends largely upon the accurate and timely calibration of the hydrometers.

There is a negligible number of stationary calibrating stations in the Soviet Union, and they are usually overloaded. Shipping of hydrometers from field locations to the calibrating station and back is time consuming and requires special precautions in order to prevent damage to the hydrometer or change of its calibrating constants during transit. The organization of a large number of calibrating stations would require considerable financial and material outlays. Prior to organizing the needed number of calibrating reservoirs, in some instances it is necessary to equip most primitive installations for the calibration of hydrometers in field surroundings, especially for hydrometric work conducted in regions remote from cultural centers. However, the usual methods of field calibration are quite imperfect.

In this article is described an experiment in organizing a field calibrating station which satisfies the requirements of simplicity and cheapness, on the one hand, and sufficient accuracy and reliability of obtained results, on the other. The complement of any calibrating station must be comprised of a reservoir of still water and a calibrating aggregate, which consists of a means to move the hydrometer all over the reservoir with various speeds, an engine capable of moving with necessary speeds, and, finally, a mechanism to register distance travelled by the hydrometer, revolutions of the blades, and time.

For the described field calibrating station, the reservoir consisted of a small lake, 500 meters long and about 150 meters wide, with the average depth in excess of 3 meters over its entire area, with the hydrometer moved along the direction of the lake's least dimension (150 meters). The calibrating aggregate (Drawing 1), constructed according to the plan of professor N. N. Zhukovskiy, consists of a light pontoon on two floats (1) or water skies, on which on rod 7 is placed the hydrometer to be calibrated, registering apparatus 5 and seat 6 for the observer, of manual winch of special construction (2) on one shore, return pulley (3) on the opposite shore, and 1 millimeter crucible steel guide wire (4). A guide wire is fastened to both ends of the pontoon, goes over the driving pulley of the winch and the pulley on the opposite shore, thus forming an endless chain. A free portion of the wire goes over the groove of horizontal disk of the registering apparatus and actuates the recording drum with a speed corresponding to that of the pontoon.

The winch of the calibrating aggregate (Drawing 2) consists of a light wooden frame stand, 2 meters long, 0.4 meters wide and 1 meter high. On the stand are set up a driving pulley (1), 636 millimeters in diameter, 2 meters in circumference along the bottom of the groove, and also an auxiliary pulley (2), 350 millimeters in diameter, mounted by means of ball bearings upon a 20 millimeter axle, and also two guide grooved rollers (3 and 4). Along the rims of both pulleys there are several parallel triangular shaped grooves cut out which are 10 millimeters wide and deep.

The pulling portion of the wire starting from the pontoon goes over the lower guide roller (3), goes over the auxiliary pulley (2) along one of its grooves and then goes over the opposite groove of the driving pulley (1), and then back over the next groove of the auxiliary and driving pulleys, then over the upper guide roller (4), proceeds to the reverse pulley on the opposite shore, going over, in the meantime, the measuring disk of the registering apparatus on the pontoon (previously mentioned). Revolution over both the pulleys (from 2 to 3) is necessary to produce sufficient friction between the drive pulley and the wire so as to avoid slipping.

All of the pulleys are of lathe turned, glued hardwood.

The drive pulley of the winch was actuated manually by two workers by means of two handles, the speed of rotation, depending on the speed of motion of the hydrometer on the pontoon, was set in seconds for one revolution, uniformity of rotation being insured by means of a metronome. The no-load movement of the pontoon toward the opposite shore was effected by reverse rotation of the drive pulley, with the registering apparatus disconnected and the hydrometer lifted out of the water.

Floats or water skies, (Drawing 1) are up to 8 meters in length and of approximately square cross-section in the middle, tapering down toward the end. The body of the floats is formed by square frames 25 x 25 centimeters, which act as a chassis, and by two longitudinal boards placed on edge. The body of the float is faced with wooded planks 1 millimeter thick, thoroughly calked and oil painted. To pump out water that might seep in each end of the float, there is a round opening 5 centimeters in diameter which has a wooden plug. Both floats are joined together by means of a grid bridging into one rigid unit. At both extreme end grids of the bridging there is the guide wire attachment. On the bridging is placed a trestle 0.5 meter high and 2 meters long, to which the recording device (5) is screwed during calibration, and upon which the observer's portable seat (6) is placed and held by iron clamps. The free length of the guide wire, after going over the disk of the measuring apparatus, passes beneath the observer's seat. In the mid part of the grid bridging (beneath the recording device and the seat), a small wooden platform with a low border is arranged, which serves to house the time-piece, contain the hydrometer, etc.

DRAWING 1: Calibrating aggregate according to the plan of professor N. N. Zhukovskiy.

DRAWING 2: Winch installation of the calibrating aggregate.

DRAWING 3: Recording device.

DRAWING 4:

[Pencil sketch of the drawings in the appendix here.]

Rod 7, upon which the hydrometer is thrust, is held in position by two bolts which go through the rod and two iron clamps attached to the trestle.

The recording device, (Drawings 3 and 4) is set up on a wooden base plate (1), which has iron strips on both sides, by means of which the device is placed on the trestle and screwed to it. To fasten other parts of the apparatus, the base plate has a metallic column (2) bolted tightly to it, to which, by means of a pair of gripping bolts, is fastened a metallic bracket (3), to which in turn is screwed a vertical girder (on the observer's side) and an irregularly shaped right angle metallic sheet (4 top).

Horizontal grooved disc (5), having a circumference of 600 millimeters, is placed 15 millimeters above the plate. The disc axis (6) has a collar fitted into the base plate and an upper bearing inside the sheet (4) of the bracket. Close to the upper end of the axis, there is placed a worm spindle 7.

To guide the guide wire into the groove of the disc, on both sides of the base plate there are fastened two horizontal metallic rollers (8). On the observer's side of the bracket-attached girder, two electromagnets (9) are set up, connected with contacts (10), by means of which one electromagnet is switched into the circuit with the hydrometer to be calibrated, and the other electromagnet is connected with the time-piece (with half second intervals). To the armature of the electromagnets two pens (11) are fastened which mark the contacts of the hydrometer and time contacts on a telegraph tape, which goes over the top portion of a round metallic drum (12), which is thrust on a horizontal axis (13), with two clamping rollers on both sides. Unreeling of the tape off spool (14) and its speed of feeding coordinated with the speed of displacement of the water skies, is effected by the rotation of drum (12), which is actuated by means of the horizontal disc (5) with the aid of the worm spindle (7) on the vertical axis of the disc, and pinion (15) on the horizontal axis of the drum. Reeling of a completed tape onto a second spool is performed manually. Distances covered by the hydrometer are measured on the tape according to a scale, which depends upon the ratio of diameters of the drum and disc (1:4), transmission ratio between the worm spindle and pinion (1:10 or 1:50) and upon the relative velocity of the free branch of the guide wire and the hydrometer (2:1). For small speeds (less than 1 meter per second) transmission ratio between the worm and pinion was taken as 1:10, and the scale of distance recording was equal to M = 2:1 x 1:50 x 1:4 = 1:100.

Distance travelled by the hydrometer was determined from the length of tape segment in accordance with

$$L = \frac{1}{M} m$$

Corresponding travel time was determined by the number N, or half second intervals as marked on the tape, and the speed V of the hydrometer was computed in accordance with

$$V = \frac{1}{0.5N_1M} \text{ m/sec.}$$

The number of blade revolutions per second N was determined by the number of intervals between contacts of the hydrometer N_2 and by the number of blade revolutions between contacts A in accordance with

$$n = \frac{aN2}{0.5\ N_1}$$

Comparison of calibrating results by the above described calibrating method of a number of hydrometers, verified in the calibrating reservoir of GGI,* with calibrating data of GGI, indicates a very satisfactory accuracy of field calibration.

Considering the simplicity and small cost of constructing and operating of a field calibrating station of the above described type, and the adequacy of its calibrating results, it can be recommended for use in hydrometric tasks of Hydrometeorological Service Administrations. For this purpose it is desirable to organize series production of the above described registering apparatus. The rest of the equipment necessary for setting up a field calibrating station can be easily constructed locally.

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APPENDIX

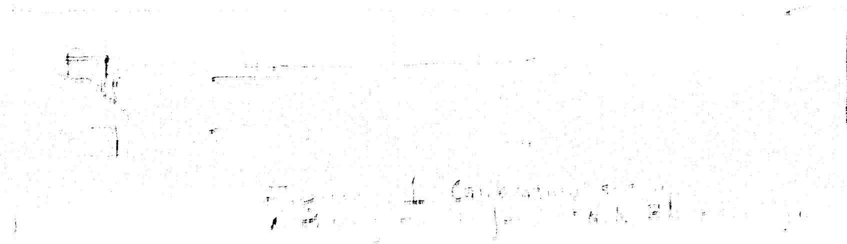

Figure 1. Calibrating [illegible]

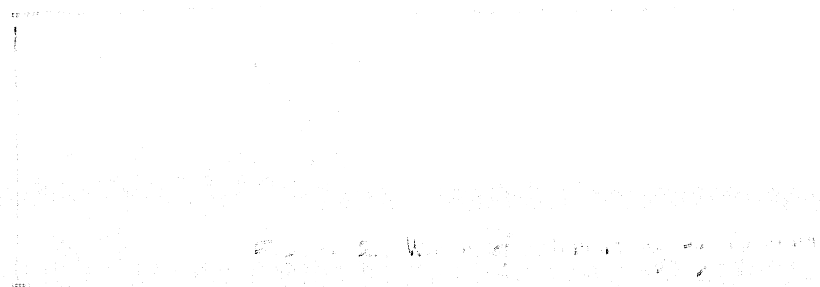

Figure 2. [illegible]

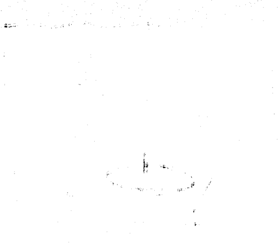

Figure 3. [illegible]

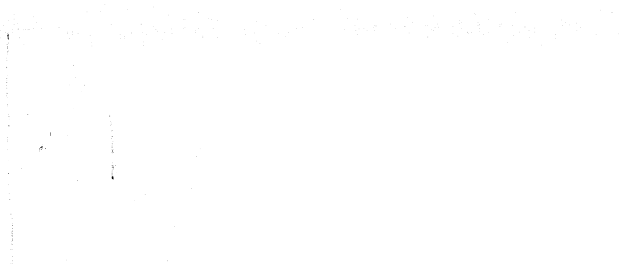

Figure 4. [illegible]

[Extra [illegible] attached here]

APPENDIX

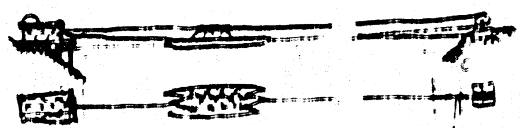

Figure 1. Calibrating set up according to Professor N.N. Zhukovskiy.

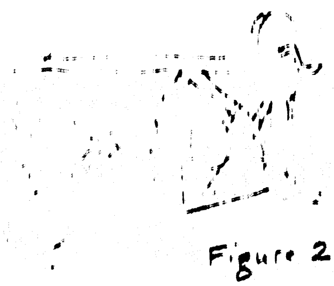

Figure 2. Winch of calibrating equipment.

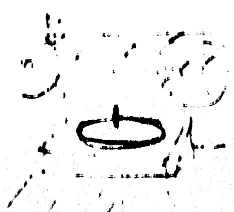

Figure 3.
Recording device.

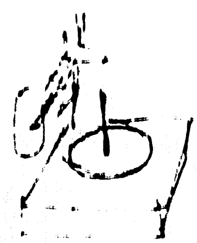

Figure 4.
Rod 7, upon which the hydrometer is set, is held in position by two bolts which go through the rod and two iron clamps attached to the trestle.